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(54) Improvements relating to teaching aids for the deaf.

(57) A teaching aid has a multi-input electronic processing unit 5 which can be combined with a small computer 1 having a screen 3 and a keyboard 4 . Model speech is input live from a teacher 11 or in recorded form (18, Figure 3). A pupil speaks into a microphone 8 and that input is processed (16,17) so that it can be made manifest in forms other than sound. The model speech is likewise processed if not already in that form on the recording medium. Model and pupil's speech can be shown as traces 12, 13 on the screen 3, and there can also be indicators 14, 15 of loudness and pitch. The characteristics can also be transformed (10) into mechanical vibrations which can be sensed by hand. Instead of side-by-side illustration, electronic comparison (20) can be made to give indications of differences between model and pupil's speech. Suitably the voice input is processed so that the words are converted into phonemes.
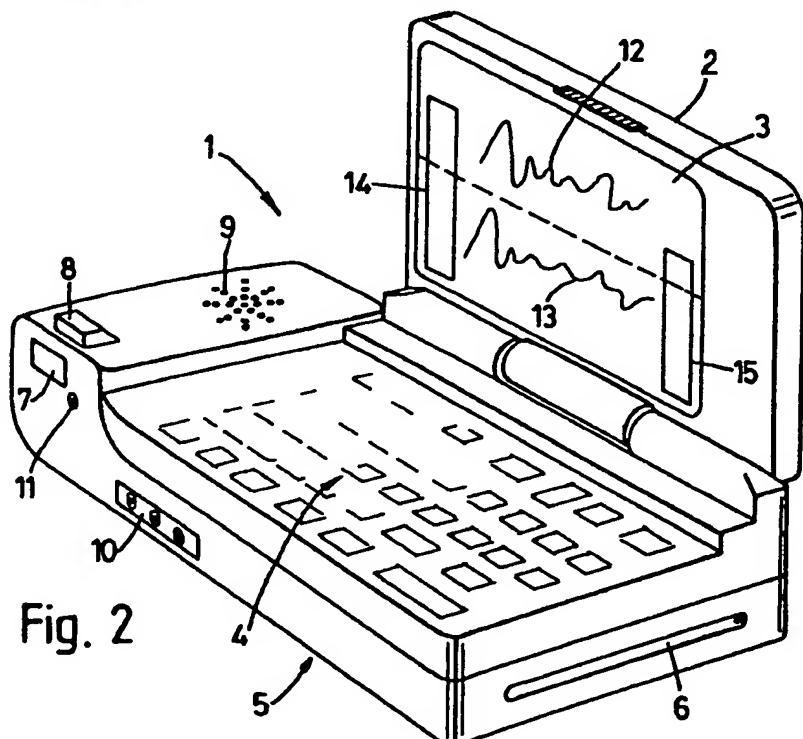

Fig. 2

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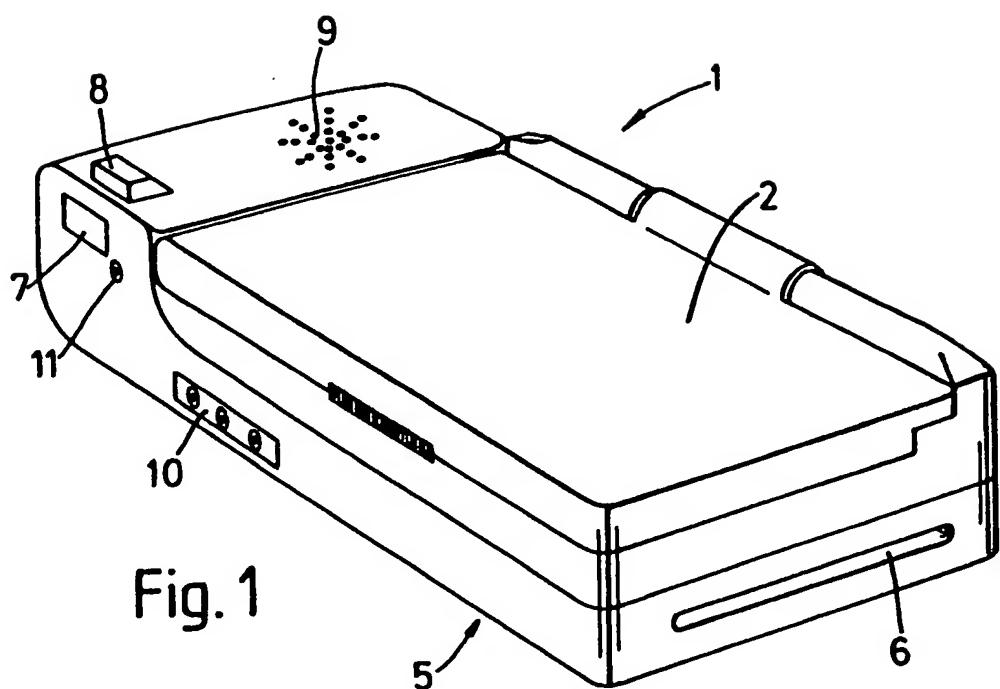
Fig. 1
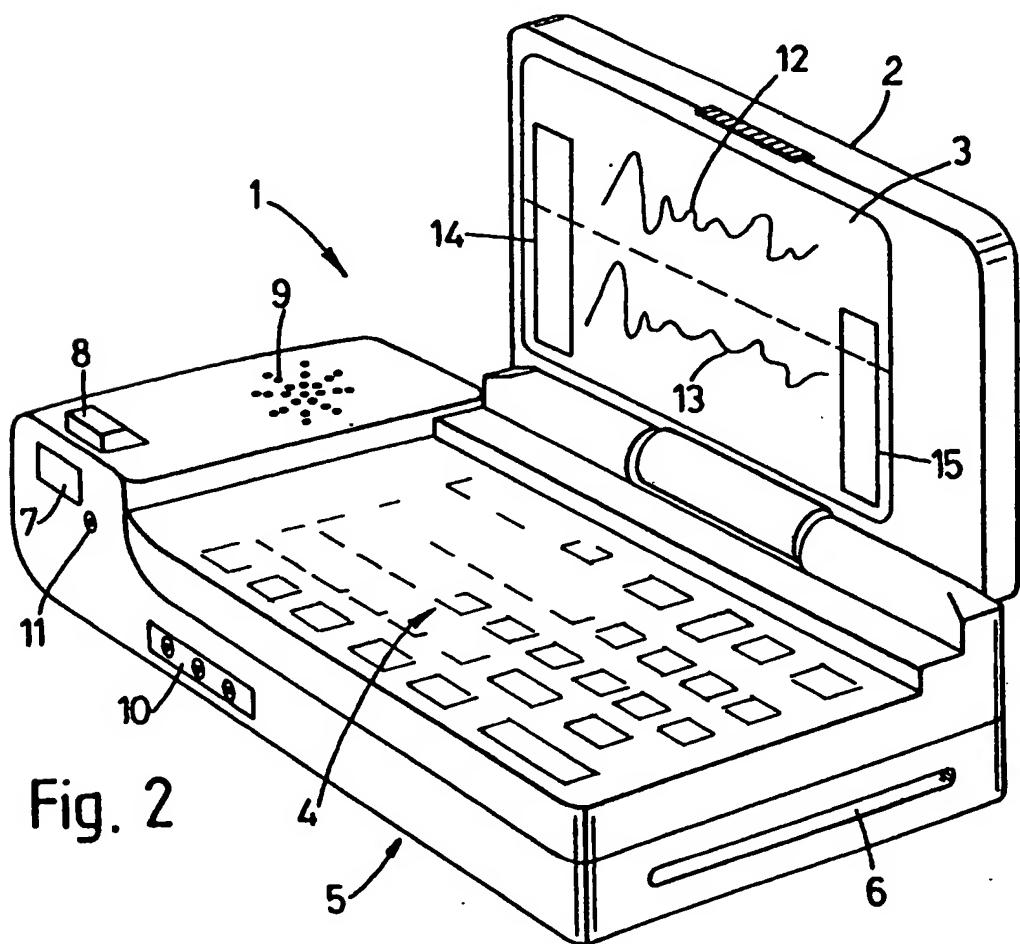
Fig. 2
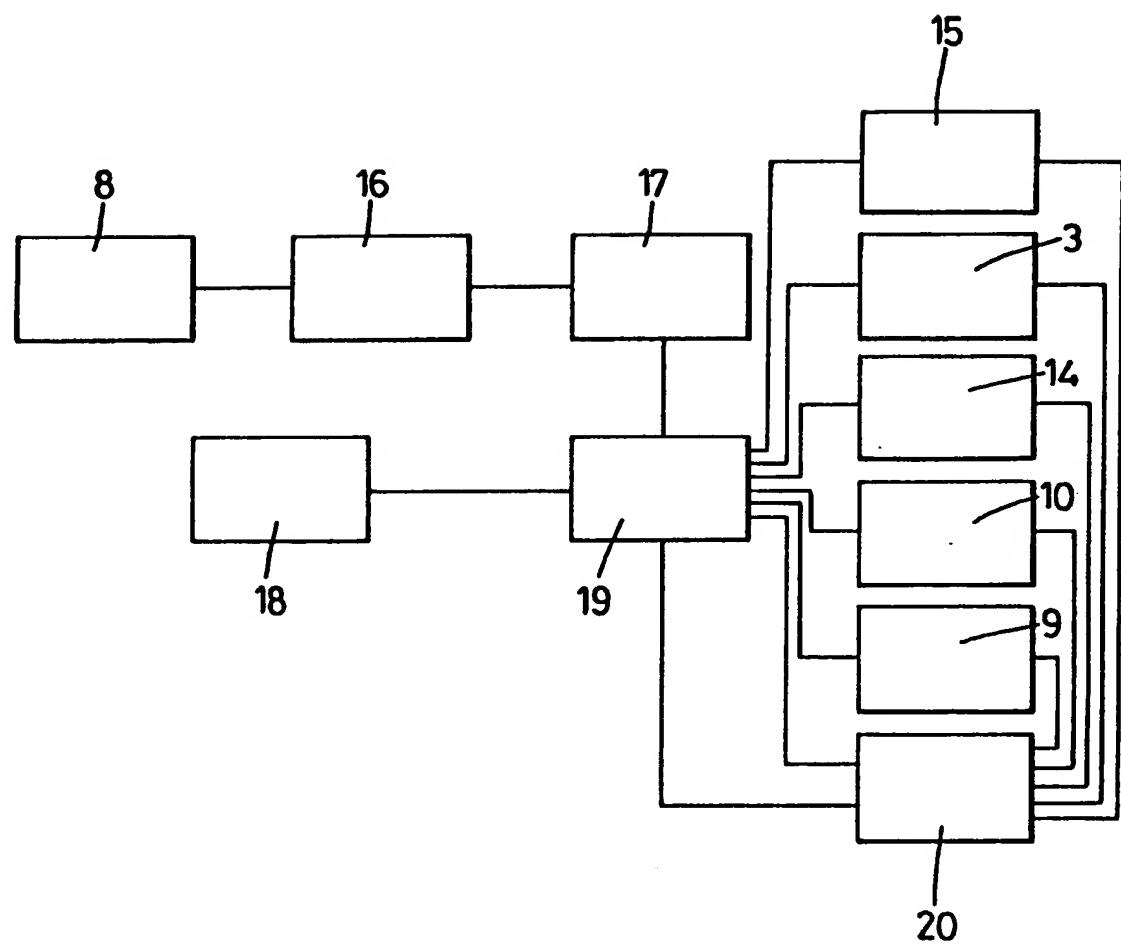
Fig. 3

"Improvements relating to Teaching Aids for the Deaf"

This invention relates to teaching aids for the deaf.

There is a considerable range of hearing-aid products on the market from which many deaf people can benefit.

5 However, very few of these products can adequately help the deaf child, or hearing-impaired child, in learning speech as well as being taught an adequate vocabulary.

Teaching of the deaf child is difficult on two counts. First, there is the need for speech-education to teach the

10 child how to make actual sounds. Second, there is a need to teach the child a vocabulary and, following on from that, to provide the child with a broad-based education. Although there are various teaching methods and devices such as the IBM "SpeechViewer" and Siemens "Fonator" available, these

15 require intensive training and teaching methods, usually on a one-to-one basis. Such teaching is usually limited to the period of time that the child is in the class, or the access it has to a computer.

A key problem for this population of learners is that

20 of a reduced attention span, with associated problems of information retention. An additional teaching problem with the deaf or hearing-impaired is the satisfactory interpretation and conveyance of a "sound" to the child, i.e. - what signals will the child need to understand how a particular

25 word, or phonetic sound, should actually be voiced.

Sound has many components and physical characteristics associated with it, and speech has additional components that are taken for granted by the normal hearing person.

Many devices at present, such as those referred to above, attempt to focus on one of these characteristics of sound, and although they are helpful, they do not present the deaf person with the full dynamic features of sound. Sound is a

5 "one-dimensional" element to them. Hence the awkward speech sometimes spoken by a deaf person.

The aim of this invention is to provide a compact but comprehensive speech-education system combined with a vocabulary-teaching system for the deaf or hearing-impaired

10 child. For convenience, reference will usually just be made to 'deaf'.

According to the present invention there is provided a teaching aid for the deaf comprising an electronic process- ing unit adapted to receive pupil's speech live and model

15 speech at least in recorded form, means for rendering the pupil speech into code and, if not already similarly coded, the model speech, and at least one output to make manifest from the coded speech the characteristics of, or the differences between, the pupil's and model speech in forms

20 other than sound.

The unit will usually also be adapted to receive a teacher's model speech live. It may be adapted to code if uncoded and to store a model speech input, and simultaneous- ly to make manifest said characteristics when the pupil

25 speech is entered.

In more detail, the model speech may already be in code, on an electronic storage device, for example, which is entered into the aid before a teaching session. When the

pupil speakes into the aid, that input is coded similarly to the model speech and it can then be arranged that the characteristics of both types of speech can be demonstrated simultaneously. Alternatively, a test piece may be entered

5 into the aid by a teacher speaking live, and this input is coded in the same way as a pupil's speech. It is then stored ready for a deaf person to attempt to mimic it. It is also possible to make provision for the pupil's speech and the model speech to be input simultaneously.

10 Preferably, one output will be a visual display. This may be adapted to show in juxtaposition representations of pupil speech and model speech. These representations may be traces on a screen.

Another possible output is to a vibrating element for

15 manual sensing.

In addition, there may be an indicator of the loudness of the pupil speech input and an indicator of its pitch. A deaf person often has little idea of the volume of his speech, or of its pitch, and it is advantageous to keep

20 those properties to reasonable limits.

In addition, the teaching aid may also have a loud-speaker for replay of recorded speech. The aid is not necessarily for the entirely deaf, and it is useful for the hard-of-hearing to be able to compare what the voice sounds

25 like on replay, to compare it with a teacher's voice emitted through the same source shortly before or afterwards.

For a better understanding of the invention, one embodiment will now be described, by way of example, with

reference to the accompanying drawings, in which:

Figure 1 is a perspective view of a teaching aid in a closed, out-of-use condition,

Figure 2 is a perspective view of the teaching aid in
5 its open, in-use position, and

Figure 3 is a block circuit diagram of part of the teaching aid.

In this embodiment, use is made of existing technology in the form of a commercially available palm-top computer 1
10 having a hinged lid 2 which, when opened up, reveals a screen 3 on its underside, while the main body presents a keyboard 4 in the usual QWERTY form.

Associated with this is an electronic processor unit 5 which provides a platform for the computer 1 to make the
15 complete aid a neat package as seen in Figure 1. This unit 5 has a slot 6 into which a cartridge carrying a teaching program can be entered. Also visible are an on/off switch 7, a microphone 8, a loudspeaker 9, a vibrator output 10, and an input socket 11 for a remote microphone. It will be
20 understood that a complete all-in-one aid could be built, effectively combining the computer 1 and unit 5.

As well as showing words which may be typed using the keyboard 4 or derived from the teaching program, the screen 3 can also display graphics as shown in Figure 2. There are
25 two traces 12 and 13 one above the other, and as described in more detail below, these can represent the characteristics of a word or sentence as spoken by a teacher and as spoken by a deaf person or hard-of-hearing pupil. The aim

will be for the pupil to try to speak so that his trace 13 matches the model one 12. On one side of these there is a vertical bar graph 14 which can indicate the loudness of the pupil's speech, and at the opposite side there is another

5   bar graph 15 indicating its pitch. Instead of being on the screen, these indicators may be elsewhere and in a different form. For example, they could each consist of an array of pin-point lights on the unit 5, the number of lights illuminated corresponding to the loudness or pitch. Another

10   way would be to have a flashing light for each indicator, the flash frequency increasing with loudness and pitch, respectively.

     The manner of use can be selected by operating certain keys of the keyboard 4. For example, visual display only can

15   be chosen, vibration only, loudpseaker playback only, or a combination of any of those. The keyboard will also be used to select a program from the cartridge in the slot 6, or to set the aid up for direct speech input from the teacher.

     Referring now to Figure 3, the basic circuit of the

20   unit 5 is illustrated. The output of the microphone 8 is digitised in a digital signal processor 16 and this is then fed to a voice analysis system 17. This converts the words into phonemes so that their component parts are readily demonstrable in a manner recognisable to a deaf person.

25   The block 18 represents educational training software on the cartridge which is entered into the slot 6. This may be pre-programmed and sold as an "off the shelf" package. In that case, it might take the form of a CD-ROM comprising an

ISD chip and supporting memory. Alternatively, it could be personalised and made unique for a particular pupil by a teacher. In that case, a programmable EPROM would be suit- able.

5   As indicated above, what is demonstrated to the pupil is governed by operation of the keyboard 4, which regulates an output unit 19 to select from the system 17 and the software 18. This feeds to the vibrator 10, the loudness visual indicator 14, the pitch indicator 15, the trace

10   display 12,13, the loudspeaker 9, and to a voice activated comparator 20.

Assuming a pupil is to be taught using the visual response, the training program may display on the screen a word or sentence in script (not shown) with the correspon-

15 ding trace 12 when properly spoken. Alternatively, the screen might show a picture, for example of an animal or a domestic artefact, with a trace corresponding to the spoken word such as "elephant" or "table". This trace will not be transitory; it will remain while the pupil attempts to

20   reproduce it by speaking into the microphone. As he does so, his speech is transformed in the processor 16 and voice analysis system 17, and passed by the output unit 19 to the display 3. The trace 13, inevitably somewhat different from the model trace 12, appears below the latter. Again, it is

25   not transitory, but is held for some time or until an erase key is pressed so that the distinctions can be noted. Just the pupil trace 13 may be erased, leaving the model trace 12. The pupil may then speak the word or sentence again in

an attempt to improve on that particular test, and this could be repeated many times.

The response of the loudness indicator 14 may fluctuate with the pupil's speech, so that there is instantaneous guidance. The screen could be marked so that the pupil would aim to keep the top of the bar of the bar graph between certain limits. Above that range would be too loud, while below it would be too soft. Meanwhile, the loudness level could be averaged and at the end of a word or sentence this average could be displayed.

Similar principles apply to the pitch indicator 15. For young boys and girls, who are expected to be the main users of this equipment, the voice is naturally pitched high. But for adult male use (teacher or pupil) a pitch indicator tuned for high voices would give a misleading result. There may therefore be provision for transposing a low-pitched input to a higher frequency range. Thus the indicator 15 will show relative variations of pitch.

Instead of a pupil working on his own and taking his models from the program 18, which can be in coded form similar to the output of the system 17, a teacher can speak directly into the aid, for example using the remote micro-phone facility 11, while the pupil uses the inbuilt one 8. With a splitter and multiple leads, a teacher can instruct a class of pupils each equipped with this aid. Obviously, the teacher's speech will also have to be processed in the same way as that of the pupil, and with switching or multiplexing the units 16 and 17 can process both teacher's

and pupil's speech. Alternatively separate units 16 and 17 could be provided. At the same time, or rather just previous to the exercise, the teacher can type in the word or sentence he is speaking so that it also appears in script on

5   the screen 3. Both pupil and teacher can speak at the same time: it is often useful for a pupil to mimic lip movements, which is more easily done simultaneously. Alternatively the teacher could speak first (and in that case he could use the microphone 8 rather than the input 11) while his input is

10   recorded, and then ask the pupil to follow.

If the vibration facility is to be used, the output 10 will produce two electrical outputs varying in correspondence with speech patterns but in a frequency range that can be directly transformed into mechanical vibrations, of

15   diaphragms for example, capable of being sensed by a user contacting them. Thus the pupil might hold or touch an element that will vibrate in a manner characteristic of the model speech. He would then speak himself, trying to reproduce the same sensations. However, comparison would

20   probably best be done simultaneously, with the pupil holding or touching vibrator elements with separate hands, one element having the model output while the other element is the pupil's output.

The loudspeaker 9 is provided so that those with

25   partial hearing can listen to model speech and then try to reproduce it. The means for converting the coded signal from output unit 19 into a form which will drive the loudspeaker are not shown for simplicity.

As mentioned above, these facilities do not have to be used separately: they can be run simultaneously.

The comparator 20 does not have a function to perform if the acts of comparison are carried out by pupil and teacher. In other words, with two traces 12 and 13 visible on the screen, or with two manual sensing elements, there is no need electronically to compare the speech characteristics and generate an output indicative of differences. However, there is a different approach where this could come in, particularly with a coloured display screen 3. For example, the screen could show a single speech trace representing the model or teacher's version of the word(s). When the pupil speaks, the comparator 20 may be voice activated simultaneously to compare the model and pupil inputs and, where they differ, to produce an output that will alter the displayed model trace, for example by locally changing its colour. The pupil will try to keep the trace monochrome and will soon get to know by the nature of any colour change how he has departed from the target sound at that point of the word or sentence. Similarly, the loudness and pitch indicators 14 and 15 could indicate by colour whether the pupil was too loud or soft or too high or low. The vibrator output could be a difference signal, which would only become appreciable when the pupil departed from the model speech. The pupil would then need only one element to sense and his object would be to feel very little or no vibration. Likewise, the loudspeaker would respond to a difference signal, and this could be translated into a frequency range

most advantageous to the hard-of-hearing pupil.

CLAIMS

1. A teaching aid for the deaf comprising an electronic processing unit adapted to receive pupil's speech live and model speech at least in recorded form, means for rendering the pupil's speech into code and, if not already similarly coded, the model speech, and at least one output to make manifest from the coded speech the characteristics of, or the differences between, the pupil's and model speech in forms other than sound.

2. A teaching aid as claimed in Claim 1, wherein the unit is adapted to receive a teacher's model speech live.

3. A teaching aid as claimed in Claim 1 or 2, wherein the unit is adapted to code if uncoded and to store a model speech input, and simultaneously to make manifest said characteristics when the pupil speech is entered.

4. A teaching aid as claimed in Claim 1, 2 or 3, wherein one output is a visual display.

5. A teaching aid as claimed in Claim 4, wherein the visual display is adapted to show in juxtaposition representations of pupil's speech and model speech.

6. A teaching aid as claimed in Claim 5, wherein the representations are traces on a screen.

7. A teaching aid as claimed in any preceding claim, wherein another output is to a vibrating element for manual sensing.

8. A teaching aid as claimed in any preceding claim, and further comprising an indicator of the loudness of the pupil speech input.

9.   A teaching aid as claimed in any preceding claim, and further comprising an indicator of the pitch of the pupil speech input.

10.   A teaching aid as claimed in any preceding claim, and further comprising a loudspeaker for replay of recorded speech.

Patents Act 1977 Examiner's report to the Comptroller under Section 17 (The Search report)	Application number GB 9322493.9

Relevant Technical Fields (i) UK Cl (Ed.M) G5G (ii) Int Cl (Ed.5) G09B	Search Examiner R A H CASLING
	Date of completion of Search 13 JANUARY 1994
Databases (see below) (i) UK Patent Office collections of GB, EP, WO and US patent specifications. (ii)	Documents considered relevant following a search in respect of Claims :- 1 TO 10

Categories of documents

X: Document indicating lack of novelty or of inventive step.

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A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages	Relevant to claim(s)
X	GB 2242772 A (B.T.) see page 4 line 27 et seq and page 5 line 21 et seq	Claim 1 at least

Databases:The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).